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Brachiocephalic vein confluence stenosis treated by two Wallstents using 'Y' technique

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Summary

Background: *Patency of the central veins is mandatory for proper function of hemodialysis fistula created at the upper extremities.*

Case report: *We present a case of dilatation of right brachiocephalic vein (RBCV) stenosis using a Wallstent implanted through the wall of another Wallstent, which had formerly been inserted into the left brachiocephalic vein and the superior vena cava (SVC). The left subclavian vein was subsequently permanently occluded which rendered the left upper extremity unsuitable for hemodialysis. PTA and implantation of a Wallstent extending from the RBCV to SVC through the wall of the initial stent proved very easy and apparently the only way to restore percutaneously normal flow and relieve congestion of the right arm.*

Conclusions: *The optimal method of stent implantation into the large-size, branching vessels remains to be established. A comparative, observational study of various techniques may help to indicate the best approach to the problem.*

Key words: central venous occlusion • bifurcation • self-expandable stents • angioplasty • chronic hemodialysis

BACKGROUND

Obstruction of central veins is a serious, but common complication of chronic hemodialysis, which develops in ca. 15% of patients [1,2]. It is usually related to cannulation of central veins [3], often performed in these patients. Obstruction usually results in severe edema of the upper extremity and necessitates prompt treatment. This is popularly accomplished percutaneously by stent implantation, which has become the standard therapeutic regimen in many centers and has been considered the treatment of choice by the National Kidney Foundation Dialysis Outcomes Quality Initiative [4]. The procedure is easy to perform and carries a low complication rate, but recurrences are common – in expert hands, the 2-year primary and secondary patency is achieved in only 28% and 81%, respectively [1], but rates as low as 9% and 22%, respectively, have been reported [5–7]. While surgical reconstruction of central veins is feasible, it requires considerable expertise and carries a significant risk in patients with chronic renal insufficiency. We report an unusual superior vena cava (SVC) and right brachiocephalic vein (RBCV) stenting in a case where stenting of the left brachiocephalic vein (LBCV) performed beforehand was complicated by partial stent migration to the SVC.

CASE REPORT

A 64-year-old female was referred to our Department for treatment of right upper extremity edema. She had been on chronic hemodialysis for 15 years and had had several hemodialysis fistulae created on both upper extremities. She had also had subclavian and internal jugular veins cannulated on both sides whenever hemodialysis fistula had failed. Two years before, a short occlusion of left brachiocephalic vein developed causing a severe left upper extremity edema. The patient had a functioning hemodialysis fistula on her left arm at that time. The vein was subsequently successfully recanalized using femoral access, but the results of a percutaneous balloon angioplasty (PTA) were poor due to recoil and an EasyWallstent (Boston Scientific, Galway, Ireland, 4 cm × 14 mm at full expansion) was implanted within the occlusion. When the carrier catheter on which the stent was mounted was being withdrawn, it accidentally pulled the stent which then partially slid to the superior vena cava (SVC). Therefore, another EasyWallstent (8 cm × 14 mm at full expansion) was immediately implanted to cover the original stent and prevent its further migration (Figure 1). At the end of the procedure, the brachiocephalic vein was open wide and there was no obstruction to flow from neither brachiocephalic vein. However, a few months later severe intimal hyperplasia and occlusion of the left sub-

Figure 1. Completion angiogram after dilatation of the left brachiocephalic vein (performed 2 years ago). A Wallstent, which has partially migrated to the superior vena cava is held in place by another Wallstent which covers its distal end.

Figure 2. Digital subtraction angiography of the right subclavian artery, venous phase. A tight stenosis of proximal part of the right brachiocephalic vein near the stent protruding to the superior vena cava is seen. Note: a permanent hemodialysis catheter is placed in the right brachiocephalic vein with its tip in the distal end of the azygos vein.

clavian vein developed resulting in marked edema of the upper extremity, despite the fact that the left internal jugular vein and the left brachiocephalic vein remained patent. Attempts of recanalization of the vein, even by means of 'sharp technique' (using a Rosch-Uhida needle [8]) failed and finally the fistula was excluded. Another hemodialysis fistula was therefore created on the patient's right forearm. Once it failed, a permanent dialysis catheter was implanted into the right subclavian vein. Still another hemodialysis fistula was created on the right arm, but then a marked edema of the extremity developed which would significantly increase whenever it was attempted to use the fistula for hemodialysis.

On digital subtraction angiography, a tight stenosis at the junction of RBCV and SVC, i.e. at the level where the stent implanted into LBCV was protruding to the SVC was visible (Figure 2). The left internal jugular and left brachiocephalic veins were patent. Mean pressure gradient through the stenosis measured when a 4F diagnostic catheter was pulled back from the right brachiocephalic vein to the SVC through the stent interstices was 8 mmHg.

We decided to perform a percutaneous dilatation and to implant a stent extending from the right brachiocephalic vein to the SVC adjacent to the stent protruding from the left brachiocephalic vein (creating a 'double barrel' stenting of the SVC). However, despite several attempts and use of both femoral and internal jugular access, various diagnostic catheters and a hydrophilic guidewire (Radifocus, Terumo, Tokyo, Japan) we could not pass the catheter between the vein wall and the stent protruding from LBCV. Therefore, we performed a PTA with balloons inserted from the SVC to RBCV through interstices of the stent. It proved to be very easy and effective - the stent wall was sequentially dilated using balloons of 5, 8, 10 and then 12 mm diameter and dilatation pressures not exceeding 6 atm, which were sufficient for the waist of the balloon at the stent wall crossing to disappear. We did not experience any technical difficulties during the PTA – the balloons did not rupture nor were there any problems in removing them after dilatation. As the opening within the stent wall created in this way appeared wide, and the effect of PTA at the level of RBCV was insufficient due to recoil (with a residual stenosis of 70%), an EasyWallstent 14×50 (Boston Scientific, Galway, Ireland) was implanted, spanning from the RBCV to the SVC crossing the wall of dilated stent so that the stents formed a letter Y (Figure 3). There was no residual stenosis of the superior vena cava, but a moderate stenosis was found at the origin of RBCV, which did not respond to further PTA. As the mean pressure gradient at this level was only 2 mmHg, we decided not to implant any more stents and the procedure was completed. The permanent hemodialysis catheter was uneventfully removed later. A marked clinical improvement was seen – the forearm edema disappeared completely overnight and it did not recur during subsequent hemodialyses. The patient died 8 months later due to unrelated causes – until then the fistula had served well and the extremity edema had never recurred.

Discussion

Stent implantation provides an effective way of relieving obstruction of central veins. It is not known, however, what is the most secure way of relieving stenosis when stents must be implanted to both brachiocephalic veins and the SVC: should one stent be implanted side by side with the other (so that the stent form a 'double barrel') or rather should a hole in the wall of one stent be creat-

Figure 3. Completion angiogram: Wallstent in the right brachiocephalic vein extending through the wall of a Wallstent protruding from the left brachiocephalic vein into the superior vena cava. Please note the proximal end of the second Wallstent, which is well within the body of the first stent and therefore does not come in contact with the wall of the superior vena cava.

ed through which the other stent is implanted (forming a letter 'Y')? Intuitively, we initially chose the first solution and switched to the other only when we were unable to proceed with the 'double barrel' technique. Was it, however, the best way of handling the problem?

Stent-in-stent stenting of branching vessels has mostly been reported with regard to balloon-expandable stents and vessels of much smaller size [9–11]. The 'Y' technique has so far been reported with regard to Wallstents implanted in few cases: during biliary procedures [12], TIPS [13] and in subclavian vein stenosis [14]. We are aware of only two series published so far, which assessed the safety and effectiveness of 'double barrel' technique with regard to large-size stents implanted in central veins for malignat SVC occlusons. Kishi el al. [15] reported that the greater diameter of the SVC (and also greater degree of improvement in venous pressure gradient) could be obtained when a single large self-expandable stent was implanted from a brachiocephalic vein through the SVC than with double-barreled stents (which might each have a smaller diameter and be more prone to occlusions). Similar conclusions were made by Nicholson et al. [16] based on their experience. To our knowledge, there have been no studies conducted so far, which would assess the safety and effectiveness of 'Y' technique nor directly compare 'Y' and 'double barrel' techniques with regard to large-size, self-expandable stents used for central vein stenting. The instruction brochure provided by the Wallstent manufacturer does not cover the subject.

Recently, a fatal complication of 'double barrel' stent implantation within the SVC was reported [17]. The authors implanted two 16×56 mm Wallstents into either brachiocephalic vein and the SVC in a patient with small cell lung cancer complicated by the superior vena cava syndrome. The patient died shortly after the procedure. On autopsy, it was found that a bare strut at the end of one of the stents perforated the vein wall, which resulted in cardiac tamponade and death. As the exact mechanism of this catastrophic event may not be fully elucidated, the authors emphasize that the wall of the SVC is thin and therefore easy to perforate, and indicate the possible influence of cardiac motion on the fatal outcome. We would add that in the 'double barrel' technique the stents are not in contact with the vessels walls on a substantial part of their circumference, which may make them prone to longitudinal movements, and emphasize that the radial tension exerted by two 16 mm Wallstents on the SVC wall must have been considerable.

On the other hand, neither exceedingly high tension exerted on the vessel wall nor excessive movements are present in the 'Y' technique. It is easy to choose a stent that will fit both the brachiocephalic vein and the SVC without much oversizing, and, as the first stent adheres well to the SVC wall, excessive movements may be prevented. It may be easy to position the other stent so that its proximal end lies within the body of the first stent. Therefore, the second stent, which is not supported by the vessel wall and possibly prone to longitudinal movements, will not come in contact with the SVC. There are, however, some drawbacks of 'Y' stenting. First, it may be more difficult, if not impossible, to pass a catheter or pacemaker wire from the subclavian or internal jugular vein into the SVC at one side of the body. In the 'Y' technique, there is free access to the SVC from only one brachiocephalic vein – entrance from the other side is obscured by the side wall of the stent. Furthermore, creating a large hole in a side wall of a Wallstent may significantly weaken its structure, even leading to stent fracture and dislocation of its parts. Moreover, wires forming the mesh of the stent may break during balloon dilatation and cause damage to the vessel wall. However, by the time a PTA is performed through the wall of the initial stent, it is already well anchored both in the brachiocephalic vein and the SVC, which should prevent it from dislocation should the stent break. Furthermore, the second stent compresses the initial stent against the vein wall, which both prevents the initial stent from migration and from movements of (possibly) sharp wires against the wall of the vein.

The optimal method of stent implantation into the large-size, branching vessels remains, however, to be established. A comparative, observational study of the 'double barrel' and 'Y' techniques may help to indicate the best approach to the problem.

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